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PROJECT ON

LIBRARY MANAGEMENT SYSTEM

BY

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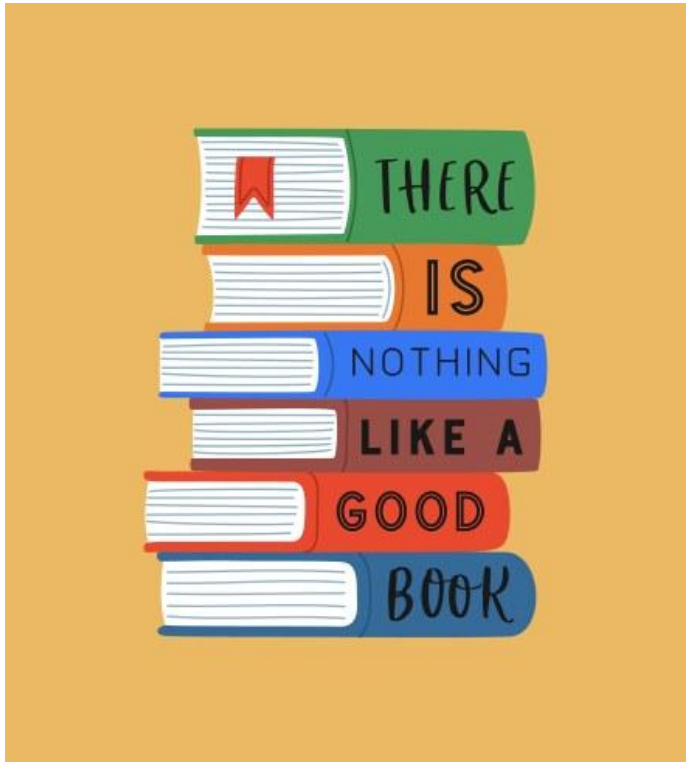
About me

- Background? (B-tech or M-tech)
- Why you want to learn Data Science
- Any work experience
- Share your LinkedIn and GitHub profile URLs

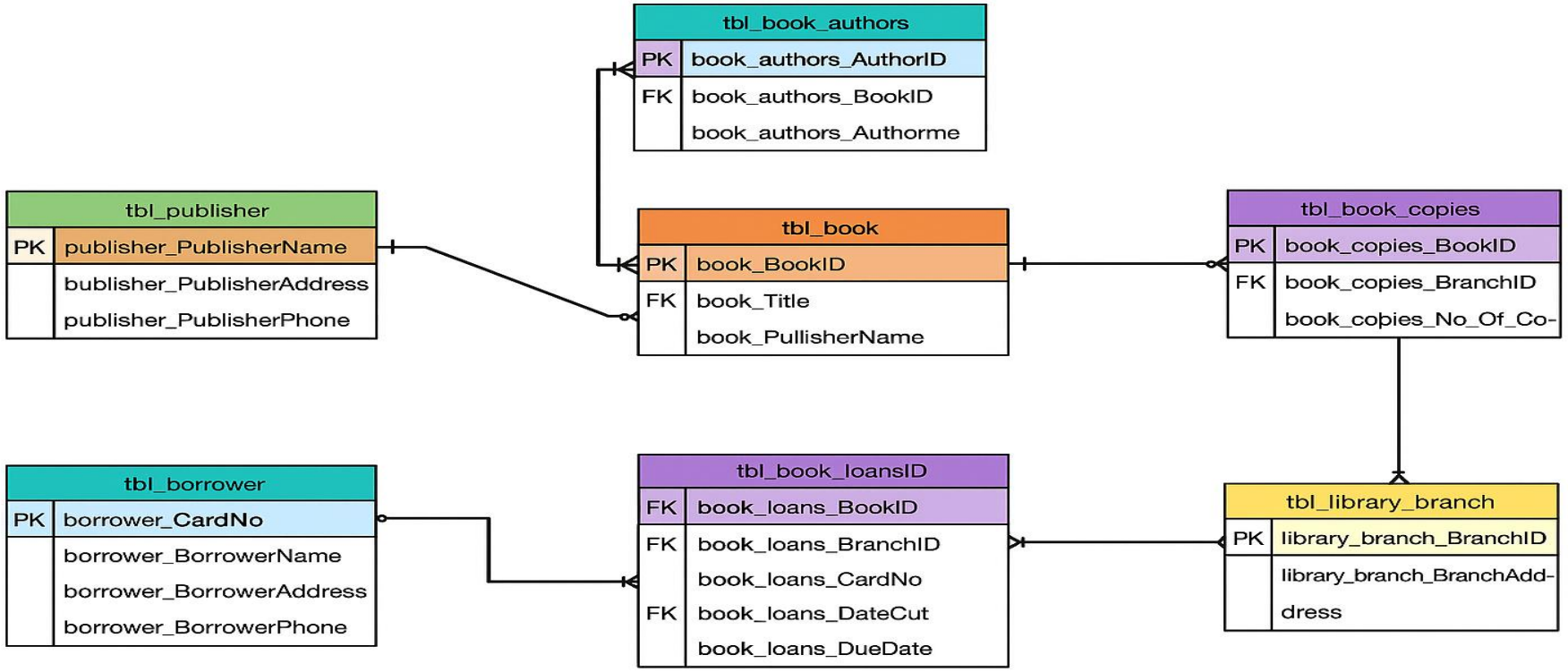
OBJECTIVE OF THE PROJECT

- The main objective of this project is to understand how a library operates by creating and analyzing a complete SQL database.
- The project focuses on organizing books, authors, publishers, borrowers, and branch information in a structured way, and then performing SQL queries to study how books are distributed across branches, how borrowers use the library, and how often books are issued.
- The goal is to turn raw data into meaningful insights that help improve library management.



ER DIAGRAM

Data Model:



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SCHEMA EXPLANATION

The schema represents the complete relational structure of a Library Management System. It organizes data into 7 related tables, each serving a specific role in managing books, authors, publishers, borrowers, and loan operations.

1. tbl_publisher (Publisher Details):

- ✓ Stores information about book publishers.
- ✓ publisher_PublisherName is the **Primary Key**.
- ✓ Each publisher can publish **multiple books**, forming a **one-to-many** relationship with tbl_book.

2. tbl_book (Book Information)

- ✓ Contains details about each book in the library.
- ✓ book_BookID is the **Primary Key**.
- ✓ book_PublisherName is a **Foreign Key** referencing tbl_publisher.
- ✓ A book can have **multiple authors** and **multiple copies**.

3. tbl_book_authors (Authors of Books)

- ✓ Stores the list of authors for each book.
- ✓ book_authors_AuthorID is the **Primary Key**.
- ✓ book_authors_BookID is a **Foreign Key** referencing tbl_book.
- ✓ Supports **one-to-many**: one book → many authors.

4. tbl_library_branch (Library Branch Information)

- ✓ Stores each library branch's name and address.
- ✓ library_branch_BranchID is the **Primary Key**.
- ✓ Each branch can have many copies of books and can issue many loans.

5. tbl_book_copies (Book Inventory Across Branches)

- ✓ Shows how many copies of each book are available at each branch.
- ✓ book_copies_CopiesID is the **Primary Key**.
- ✓ Contains two **Foreign Keys**:
  - book_copies_BookID → tbl_book
  - book_copies_BranchID → tbl_library_branch
- ✓ Represents a **many-to-many relationship** between Books and Branches, resolved through this table.

6. tbl_borrower (Borrower Information)

- ✓ Stores borrower details such as name, address, and phone.
- ✓ borrower_CardNo is the **Primary Key**.
- ✓ Each borrower can check out multiple books.

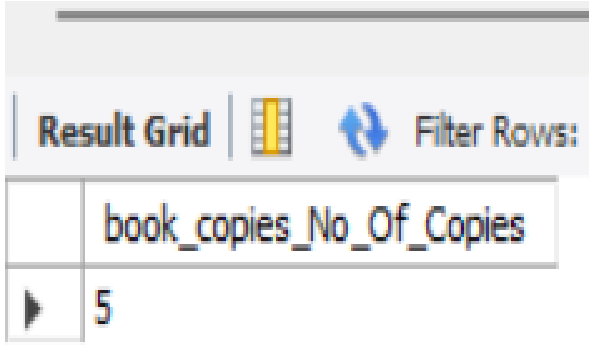
7. tbl_book_loans (Book Issue Details)

- ✓ Tracks all issued books and their due dates.
- ✓ book_loans_LoansID is the **Primary Key**.
- ✓ Contains three **Foreign Keys**:
  - book_loans_BookID → tbl_book
  - book_loans_BranchID → tbl_library_branch
  - book_loans_CardNo → tbl_borrower

Key analysis questions (use cases)

1. **How many copies of the book titled "The Lost Tribe" are owned by the library branch whose name is "Sharpstown"?**

```
SELECT bc.book_copies_No_Of_Copies
FROM tbl_book_copies bc
JOIN tbl_book b
    ON bc.book_copies_BookID = b.book_BookID
JOIN tbl_library_branch lb
    ON bc.book_copies_BranchID = lb.library_branch_BranchID
WHERE b.book_Title = 'The Lost Tribe'
  AND lb.library_branch_BranchName = 'Sharpstown';
```



2. How many copies of the book titled "The Lost Tribe" are owned by each library branch?

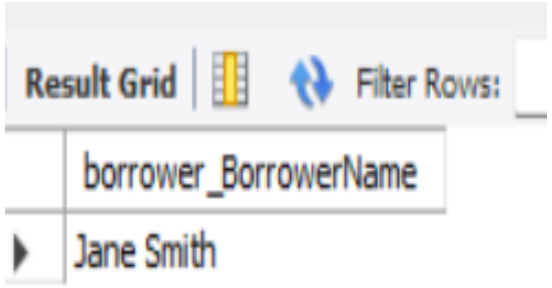
```
SELECT lb.library_branch_BranchName,
       bc.book_copies_No_Of_Copies
FROM tbl_book_copies bc
JOIN tbl_book b
    ON bc.book_copies_BookID = b.book_BookID
JOIN tbl_library_branch lb
    ON bc.book_copies_BranchID = lb.library_branch_BranchID
WHERE b.book_Title = 'The Lost Tribe';
```

Result Grid | Filter Rows: | Export:

library_branch_BranchName	book_copies_No_Of_Copies
Sharpstown	5
Central	5
Saline	5
Ann Arbor	5

3. Retrieve the names of all borrowers who do not have any books checked out.

```
SELECT b.borrower_BorrowerName
FROM tbl_borrower b
LEFT JOIN tbl_book_loans bl
    ON b.borrower_CardNo = bl.book_loans_CardNo
WHERE bl.book_loans_CardNo IS NULL;
```



4. For each book that is loaned out from the "Sharpstown" branch and whose Due Date is 2/3/18, retrieve the book title, the borrower's name, and the borrower's address.

```
SELECT
    b.book_Title,
    br.borrower_BorrowerName,
    br.borrower_BorrowerAddress
FROM tbl_book_loans bl
JOIN tbl_book b
    ON bl.book_loans_BookID = b.book_BookID
JOIN tbl_borrower br
    ON bl.book_loans_CardNo = br.borrower_CardNo
JOIN tbl_library_branch lb
    ON bl.book_loans_BranchID = lb.library_branch_BranchID
WHERE lb.library_branch_BranchName = 'Sharpstown'
  AND bl.book_loans_DueDate = '2/3/18';
```

Result Grid | Filter Rows: | Export: | Wrap Cell Content:

book_Title	borrower_BorrowerName	borrower_BorrowerAddress
The Hobbit	Tom Li	981 Main Street, Ann Arbor, MI 48104
Eragon	Tom Li	981 Main Street, Ann Arbor, MI 48104
A Wise Mans Fear	Tom Li	981 Main Street, Ann Arbor, MI 48104
Harry Potter and the Philosophers Stone	Tom Li	981 Main Street, Ann Arbor, MI 48104
Hard Boiled Wonderland and The End of the World	Tom Li	981 Main Street, Ann Arbor, MI 48104
The Hitchhikers Guide to the Galaxy	Tom Li	981 Main Street, Ann Arbor, MI 48104

5. For each library branch, retrieve the branch name and the total number of books loaned out from that branch.

```
SELECT
    lb.library_branch_BranchName,
    COUNT(bl.book_loans_LoansID) AS TotalLoans
FROM tbl_book_loans bl
JOIN tbl_library_branch lb
    ON bl.book_loans_BranchID = lb.library_branch_BranchID
GROUP BY lb.library_branch_BranchName;
```

Result Grid | Filter Rows:

library_branch_BranchName	TotalLoans
Sharpstown	10
Central	11
Saline	10
Ann Arbor	20

6. Retrieve the names, addresses, and number of books checked out for all borrowers who have more than five books checked out.

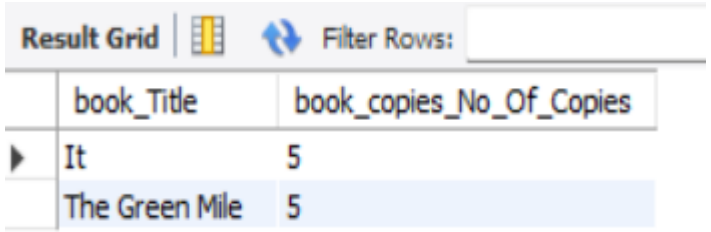
```
SELECT
    br.borrower_BorrowerName,
    br.borrower_BorrowerAddress,
    COUNT(bl.book_loans_LoansID) AS NumberOfBooks
FROM tbl_borrower br
JOIN tbl_book_loans bl
    ON br.borrower_CardNo = bl.book_loans_CardNo
GROUP BY br.borrower_CardNo, br.borrower_BorrowerName, br.borrower_BorrowerAddress
HAVING COUNT(bl.book_loans_LoansID) > 5;
```

Result Grid | Filter Rows: | Export: | Wrap Cell Content:

borrower_BorrowerName	borrower_BorrowerAddress	NumberOfBooks
Joe Smith	1321 4th Street, New York, NY 10014	7
Tom Li	981 Main Street, Ann Arbor, MI 48104	14
Tom Haverford	23 75th Street, New York, NY 10014	6
Angela Thompson	2212 Green Avenue, Ann Arbor, MI 48104	11
Michael Horford	653 Glen Avenue, Ann Arbor, MI 48104	8

7. For each book authored by "Stephen King", retrieve the title and the number of copies owned by the library branch whose name is "Central".

```
SELECT
    b.book_Title,
    bc.book_copies_No_Of_Copies
FROM tbl_book_authors ba
JOIN tbl_book b
    ON ba.book_authors_BookID = b.book_BookID
JOIN tbl_book_copies bc
    ON b.book_BookID = bc.book_copies_BookID
JOIN tbl_library_branch lb
    ON bc.book_copies_BranchID = lb.library_branch_BranchID
WHERE ba.book_authors_AuthorName = 'Stephen King'
  AND lb.library_branch_BranchName = 'Central';
```



book_Title	book_copies_No_Of_Copies
It	5
The Green Mile	5

Final business insights and recommendations

- ✓ The library data shows clear differences in book demand across branches, with some branches issuing more books than others.
- ✓ Certain authors and titles are consistently popular, highlighting the need for better inventory planning.
- ✓ A small group of borrowers accounts for most of the book loans, while others remain inactive.
- ✓ Book copies are unevenly distributed, causing limited availability in some branches.

CONCLUSION

This project helped in understanding how a library's data can be effectively managed using SQL. By building the database and running queries on real datasets, we were able to observe trends in book usage, borrower activity, and branch-level performance. The analysis shows how organized data and structured queries can support better decision-making in daily library operations. Overall, the project demonstrates the value of SQL in managing, analyzing, and improving library services.

THANK YOU

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